III. The market performance of EU bonds

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Abstract: *Since the launch of the NextGenerationEU (NGEU) and SURE programmes in the midst of the 2020-2021 COVID-19 crisis, the amount of bonds issued by the European Union has grown rapidly, and is expected to reach a market footprint comparable to that of a medium-to-large-sized EU sovereign. This section investigates the market performance of EU bonds since October 2020, when the first SURE bond was issued, focusing on their yields, spreads and liquidity measures. An empirical analysis shows that EU bonds trade with a modest, though non-negligible, spread compared to the 'risk-free' rate, tracking, to some extent, changes in the spreads of euro area Member States. At the same time, bonds issued under the NGEU and SURE programmes benefit from lower yields when compared with EU bonds issued under previous programmes. This favourable price effect is stronger at shorter maturities and fades away at longer horizons. Empirical analysis likewise suggests that the single EU green bond in the sample benefitted from a favourable 'green' label effect as at January 2022, although this result should be interpreted with caution. Finally, EU bonds issued under NGEU and SURE have been somewhat less liquid than benchmark sovereign bonds, but more liquid than EU bonds issued under previous programmes. The liquidity of EU bonds issued under NGEU and SURE is high overall and has also been increasing since mid-2021 as the total amount of EU issuance rapidly expanded and EU bills were introduced* (60)*.*

III.1. Introduction

One of the consequences of the policy response to the COVID-19 crisis has been the large-scale issuance of EU bonds to finance two temporary support schemes: NextGenerationEU (NGEU) and the Support to mitigate Unemployment Risks in an Emergency (SURE) (61). The EU had already issued bonds in the past to fund: (i) its balance-of-payments assistance facility; (ii) its macro-financial assistance programmes; (iii) the European Atomic Energy Community; and (iv) the European Financial Stabilisation Mechanism. However, the latest issuances under NGEU and SURE are remarkable for their planned total size, specific governing framework (62) and diversified funding strategy.

The first SURE bond was issued in October 2020, while the first NGEU bond appeared in June 2021. By January 2022, EUR 89.6 bn had been issued under SURE, out of a maximum issuance of EUR 100 bn. By the same date, EUR 99.9 bn had been issued as NGEU bonds and bills, out of a maximum issuance of EUR 806.9 bn (63) in long-term funding. Graph III.1 shows the increase in EU bond issuance since October 2020, while Graph III.2 shows a projection for outstanding EU bond amounts over the coming decades. Even though this projection is subject to uncertainty, notably over the degree of take-up by Member States of the NGEU loans, it shows that total EU bonds outstanding may reach more than 6% of euro-area GDP by 2026. If the EU issuer were a country, such an absolute amount of debt outstanding would place it fifth among European Member States, just behind Spain, and ahead of Belgium and the Netherlands. One segment in particular, the green bond market, is set to represent 30% of total issuance under NGEU, making the EU the world's largest issuer of green bonds.

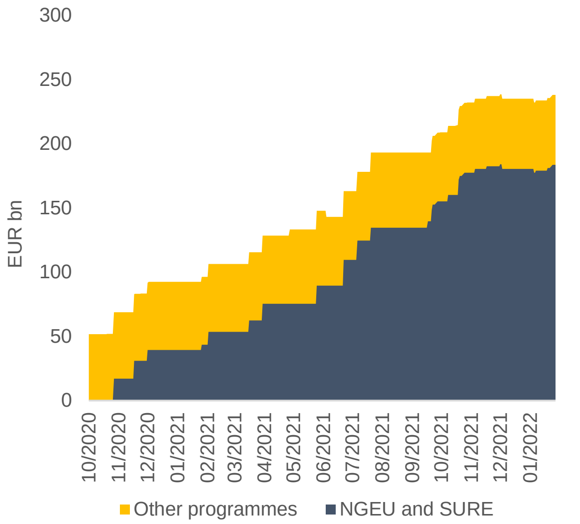
(60) The author would like to thank Puck Boom for the excellent statistical assistance, as well as Eric Ruscher, Matteo Salto and two anonymous referees for helpful comments.

(61) See https://ec.europa.eu/info/strategy/recovery-plan-europe_en and https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/financial-assistance-eu/funding-mechanisms-and-facilities/sure_en.

(62) In particular, as regards the use of the proceeds and the repayment mechanisms. For example, under NGEU the proceeds are to be applied by Member States on investments and reforms, as set out in EU-approved recovery and resilience plans. As for SURE, the proceeds seek to support employment through short-time work schemes and similar measures. On financing, NGEU and SURE have involved an expansion of the EU budget and the possibility of new EU own resources, in particular in connection with the repayment of grant-related NGEU funding. Budgetary safeguards have also been implemented, such as a system of voluntary guarantees from Member States for the SURE loans, as well as an increase in the EU's own-resources ceiling in connection with NGEU.

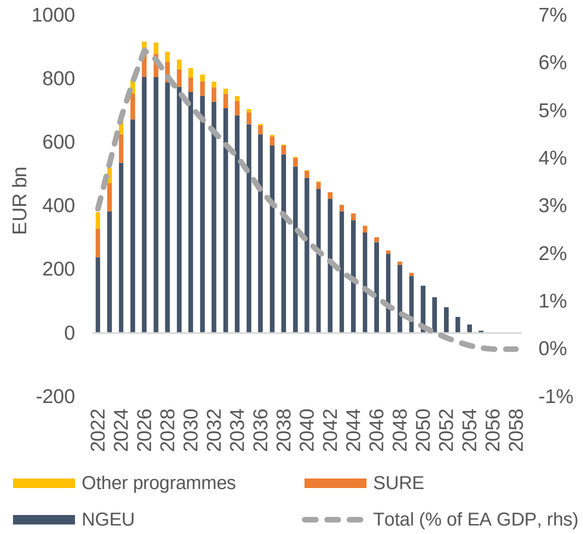
(63) Current prices.

Graph III.1: **Total EU bond amounts outstanding**



Source: Bloomberg, own calculations.

Graph III.2: **Projected EU bond amounts: 2022-2058**



(1) Projections assume no further issuance under SURE and programmes classified as 'other'.
Source: Commission projections, Bloomberg, own calculations.

NGEU and SURE bonds have been well received by investors**,** as evidenced by: (i) the large primary market demand; (ii) the low spreads compared to measures of the 'risk-free' rate (e.g. the yields on German Bunds); (iii) the strong interest shown by both domestic and foreign investors; and (iv) their AAA rating from two out of the three largest rating agencies. The diversified funding strategy of the EU ([64]) has made possible the formation of a full yield curve, which compares well with that of reference EU issuers, such as France and other EU supranationals. As can be observed in Graph III.3, EU bonds trade: (i) with a spread with respect to Germany; (ii) with no systematic spread with respect to France; and (iii) broadly in line with other EU supranationals such as the European Stability Mechanism (ESM). It is worth noting that the spread with respect to France tends to be positive at short-to-medium maturities, and negative at longer ones. In addition, the EU yield curve compares favourably with that of the ESM when considering only NGEU and SURE bonds, which generally trade at somewhat lower yields along the full maturity spectrum than EU bonds issued under previous programmes.

Large-scale issuance by the EU matters at a macroeconomic level as it has the potential to both improve the functioning of the monetary union and support important strategic objectives. The decision to issue bonds at EU level has provided an immediate confidence boost ([65]) to financial markets and to the EU economy. In addition to its positive effect in signalling Member States' commitment to the European project, EU issuance can be instrumental in: (i) developing green finance; (ii) deepening the capital markets union ([66]); and (iii) offering financial institutions more options for diversifying and de-risking their assets, thus helping to break the direct channels of the sovereign-bank loop that has afflicted European economies in the past ([67]). In addition, EU bonds provide markets with a sizeable supranational safe asset, thus helping to support the international role of the euro ([68]).

([64]) Under the EU's diversified funding strategy, lending operations to Member States are decoupled from borrowing operations by the EU (i.e. there is no 'back-to-back' lending), which can rely on different funding instruments and techniques. See: https://ec.europa.eu/info/strategy/eu-budget/eu-borrower-investor-relations/nextgenerationeu-diversified-funding-strategy_en.

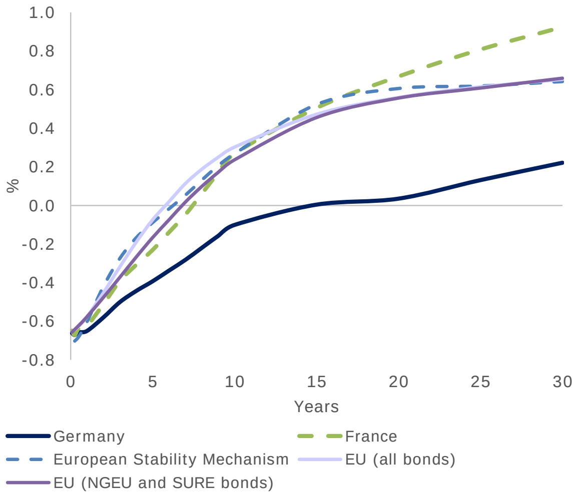
([65]) For example, this was observable in a decrease in the CDS spreads of euro-area sovereigns following: (i) the Franco-German proposal of 18 May 2020 for a recovery fund, to be financed by joint EU debt issuance; and (ii) the subsequent NGEU proposal by the European Commission on 27 May.

([66]) See for example CEPS-ECMI Task Force (2019), 'Rebranding capital markets union - a market finance action plan'.

([67]) See Bellia, M., L. Calès, L. Frattarolo, D. Monteiro and M. P. Giudici (2021), 'COVID-19: the stabilising impact of EU bond issuance on sovereigns and banks', *Quarterly Report on the Euro Area*, Vol. 20, No. 3 (2021).

([68]) For example, see Ilzetzki, E., C.M. Reinhart and K. S. Rogoff (2020), 'Why Is the Euro Punching Below Its Weight?', *Economic*

Graph III.3: **European yield curves**



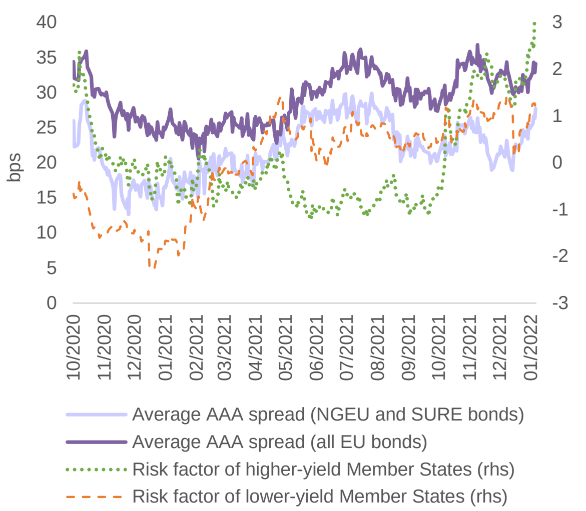
(1) As at 14/01/2022.
Source: Bloomberg, own calculations.

In the remainder of this article we conduct an empirical assessment of the market performance of EU bonds, starting with a longitudinal analysis of yield drivers since October 2020 in Subsection III.2, before moving on to an assessment of spreads as at January 2022 in Subsection III.3, and a discussion of market liquidity and its determinants in Subsection III.4. Subsection III.5 provides some concluding thoughts.

III.2. The evolution of the yields on EU bonds

Average EU bond spreads with respect to AAA euro-area sovereigns ([69]) have been small, although systematically positive since the issuance of the first SURE bond in October 2020 (Graph III.4). Spreads are also lower for SURE and NGEU bonds when compared with other EU issuances. During the period under consideration, spreads initially decreased until early 2021 and then embarked on an upward trend until summer 2021. They tended to fall somewhat in August and September 2021, and have not presented a clear trend since then. These movements correlate with risk factors in 'higher-yield' and 'lower-yield' euro-area Member States (whose spreads are calculated with respect to Germany).

Graph III.4: **EU bond spreads and risk factors**



(1) Spreads are simple averages of the bonds in the sample and are computed with respect to the yield curve of AAA euro-area sovereigns, for the relevant maturity. Risk factors are constructed as the first principal component of the 10-year spreads with respect to DE of two sets of Member States: AT, BE, FI, FR and NL ('lower-yield' countries); and EL, IE, IT, PT and ES ('higher-yield' countries). Risk factors have been normalised in the graph to zero mean and unit standard deviation.
Source: Bloomberg, ECB, own calculations.

We formalise our assessment of the evolution of the yields of EU bonds in a panel regression based on a sample of 68 bonds and bills tracked from October 2020 to January 2022 ([70]). In particular, we estimate the following equation in a random effects setting:

$$
\begin{aligned}
y_{i,t} = \alpha + \beta_1 y_{i,t}^{AAA} + \beta_2 \overline{BAS}_i + \beta_3 BAS_{i,t} + \beta_4 \bar{T}_i \\
+ \beta_5 \bar{T}_i^2 + \beta_6 Risk_t^{LY} + \beta_7 Risk_t^{HY} \\
+ \beta_8 NGEU\_SURE_i + \beta_9 Green_i \\
+ \beta_{10} (\bar{T}_i \times Risk_t^{LY}) \\
+ \beta_{11} (\bar{T}_i \times Risk_t^{HY}) \\
+ \beta_{12} (NGEU\_SURE_i \times \bar{T}_i) + \varepsilon_{i,t}
\end{aligned}
$$

where:

- $y_{i,t}$ denotes the yield of bond *i* in month *t;*
- $y_{i,t}^{AAA}$ is the yield of AAA sovereign bonds ([71]), for the same residual maturity as bond *i,* with

Policy, Volume 35, Issue 103, July 2020; De Grauwe, P. (2018), 'Economics of Monetary Union' and ECB (2019), 'The international role of the euro, June 2019'.

([69]) We consider the AAA yield curve fitted by the ECB for the euro area, available from:
https://www.ecb.europa.eu/stats/financial_markets_and_interest_rates/euro_area_yield_curves/html/index.en.html.
AAA euro-area sovereigns are those so rated by Fitch. For the period under consideration, these comprise Germany, Luxembourg and the Netherlands.

([70]) Here and elsewhere, the data on EU bond yields, bid prices, ask prices and amounts outstanding are sourced from Bloomberg.

([71]) As in Graph IV.4, we consider the AAA yield curve fitted by the ECB for the euro area.

respect to bond i's issue date; i.e., $y_{i,t}^{AAA}$ tracks the relevant risk-free rate for a given bond;

- $\overline{BAS_i}$ is the average in-sample bid-ask spread of bond i, a measure of market liquidity computed as the ask price of a bond minus its bid price (72);

- $BAS_{i,t}$ is a time series for bond i's bid-ask spread;

- $\bar{T}_i$ is the average in-sample maturity of bond i, and $\bar{T}_i^2$ the square of that figure;

- $Risk_t^{LY}$ is a risk factor computed as a rescaled (73) first principal component of the spreads of 'lower-yield' euro area sovereigns (i.e., AT, BE, FI, FR and NL) with respect to DE;

- $Risk_t^{HY}$ is an equivalent risk factor computed for 'higher-yield' euro area sovereigns (i.e., EL, IE, IT, PT, ES);

- $NGEU\_SURE_i$ is a dummy variable that takes the value of one if a bond was issued under the NGEU or the SURE programmes;

- $Green_i$ is a dummy variable that takes the value of one if bond i is a green bond;

- and $\varepsilon_{i,t}$ is an error term.

The motivation for the above specification, the estimation method and the estimated coefficients are discussed in Box III.1. The goodness-of-fit of the regression is 95% and all the parameters are statistically significant, with the exception of the parameter associated with $Green_i$ (74).

A number of relevant conclusions can be extracted from the estimated coefficient values:

1. <u>As expected, the risk-free rate is by far the main driver of EU bond yields</u>: a 10 basis point (bp) increase in the risk-free rate (for the relevant maturity) translates into an 8.2 bp increase in EU bond yields.

2. <u>The EU inherits credit risk from both the 'lower-yield' and 'higher-yield' regions</u>: a 10 bp increase in the spread of 'lower-yield' countries raises EU yields by a minimum of 2.4 bps, a figure that increases by 0.2 bps for each year of average bond maturity. Likewise, a 10 bp increase in the spread of 'higher-yield' Member States raises yields by a minimum of 0.6 bps, and by a further 0.05 bps for each year of bond maturity (75). It is worth noting that a positive credit risk dependence with respect to Member States is to be expected from the viewpoint of economic fundamentals. This is because the EU is directly exposed to EU countries via: (i) the loans it grants under NGEU (which are concentrated in the 'higher-yield' countries); and (ii) its budgetary claims on Member States, which form the basis for the repayment of the NGEU grants (with these claims being concentrated on 'lower-yield' countries, whose contributions to the EU budget are comparatively larger).

3. <u>NGEU and SURE bonds enjoy a significant price advantage</u>: bonds issued under NGEU and SURE benefit from a yield reduction when compared with EU bonds issued under other programmes, which can reach up to 11 bps as they approach zero residual maturity. This positive pricing effect fades away for longer maturities, and is no longer observable beyond the ten-year horizon.

4. <u>Liquidity matters</u>: a 10 bp increase in average bid-ask spreads increases yields by 3.8 bps, on average.

Graph III.5 provides a decomposition of the main time-varying contributors to the average yields on EU bonds, allowing us to extract a fifth relevant conclusion:

(72) The bid and ask prices that are used to calculate the BAS are expressed as a percentage of par value. For this reason, we express the BAS in basis points throughout the article.

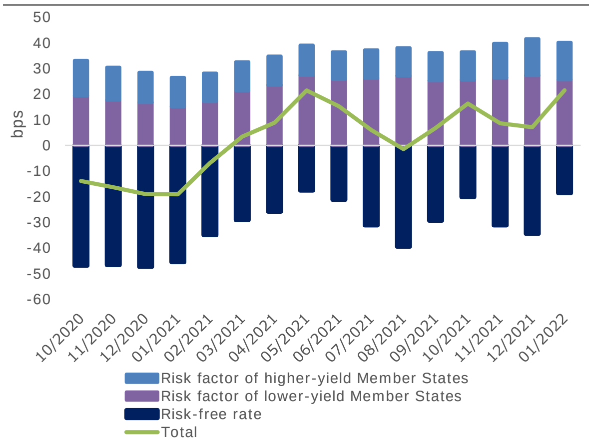
(73) More precisely, the first principal component loadings are divided by their sum, so that they add up to one and the risk factor can be interpreted in 'interest rate' percentage point terms. This normalisation method is thus different from that depicted in Graph IV.4.

(74) As explained in Box III.1, this parameter is included for specification consistency with the cross-sectional regression in the next subsection.

(75) These results do not show a priori that the EU is more exposed to movements in the spreads of 'lower-yield' countries than to movements in the spreads of 'higher-yield' countries, as the spread magnitude and volatility in the latter region has been higher than in the former one. However, the decomposition presented in Graph IV.5 ultimately demonstrates a higher exposure to the 'lower-yield' Member States.

5. The 'lower-yield' countries have been somewhat more important than the 'higher-yield' ones in driving EU bond spreads: for the period under analysis, and considering only the role of regional risk factors, 'lower-yield' euro area Member States have contributed with a relative share of 66% to average yields. This compares with a share of 34% for 'higher-yield' countries. A possible interpretation of this result would be a market perception that the 'lower-yield' countries play a larger role as ultimate guarantor of the very low risk of EU bonds. It should be noted, however, that the period under analysis was characterised by relatively low volatility in Member State spreads, and that the relative importance of the drivers could change under a regime of higher volatility.

Graph III.5: **Main dynamic drivers of the average yields on EU bonds**



(1) In simple average terms, covering all bonds in the sample at a given point in time.
Source: Own estimations.

Before concluding this longitudinal analysis of EU bond yields, it is worth noting two 'negative' results. Under the present sample and methodology, a green bond label does not confer a statistically significant change in yields ([76]). However, this result should be read with caution for two reasons: (i) it is not confirmed by the cross-sectional analysis conducted for January 2022 (see the following subsection); and (ii) there is only one green bond in the sample. Likewise, while EU short-term bills trade at very low spreads, this appears to be explained by general factors such as their short residual maturity and high liquidity, rather than by a 'bill label' per se ([77]).

III.3. EU bond spreads in January 2022: a cross-sectional assessment

This subsection takes a 'snapshot' of the drivers of EU bond spreads at a specific point in time by estimating the following cross-sectional equation for 65 EU bonds as at January 2022:

$$
\begin{aligned}
y_i - y_i^{AAA} = \alpha + \beta_{BAS} BAS_i + \beta_T T_i + \beta_{T^2} T_i^2 \\
+ \beta_{NS} NGEU\_SURE_i \\
+ \beta_G Green_i \\
+ \beta_{NS,T} (NGEU\_SURE_i \times T_i) \\
+ \varepsilon_i
\end{aligned}
$$

where the left-hand side of the equation captures bond spreads, T_i denotes bond i's residual maturity, and remaining variables have the same meaning as in the previous subsection. Focusing only on January 2022 implies strongly reducing the number of available observations, which in turn requires reducing the number of explanatory variables. The above specification can be therefore understood as a 'collapsed' form of the panel data equation previously estimated, streamlined to a lower number of estimated parameters. An advantage of taking a cross-sectional approach relates to its robustness with respect to parameter instability ([78]).

The cross-sectional equation is estimated via OLS and with robust standard errors. The goodness-of-fit is 76% ([79]) and all parameters are significant and have theoretically-valid signs. The results are reported in Box III.1 together with additional details.

Graph III.6 provides a decomposition of EU bond spreads based on the estimated cross-sectional equation, where we consider the 'average bond' ([80]) for each of the following three categories:

([76]) In other words, the inclusion of a 'green' dummy variable in the regression reveals a coefficient that is not statistically significant.

([77]) I.e. the inclusion of a 'bill' dummy variable in the regression reveals a coefficient that is not statistically significant.

([78]) I.e., if parameters are time-varying in the panel regression, the cross-sectional approach provides a picture of their value at a specific point in time.

([79]) A lower goodness-of-fit when compared with the panel data model should not be understood as evidence of lower explanatory power. Rather, it is the result of the fact that the cross-sectional regression explains spreads rather than yields. Given that spreads are a form of 'residual', they are harder to explain.

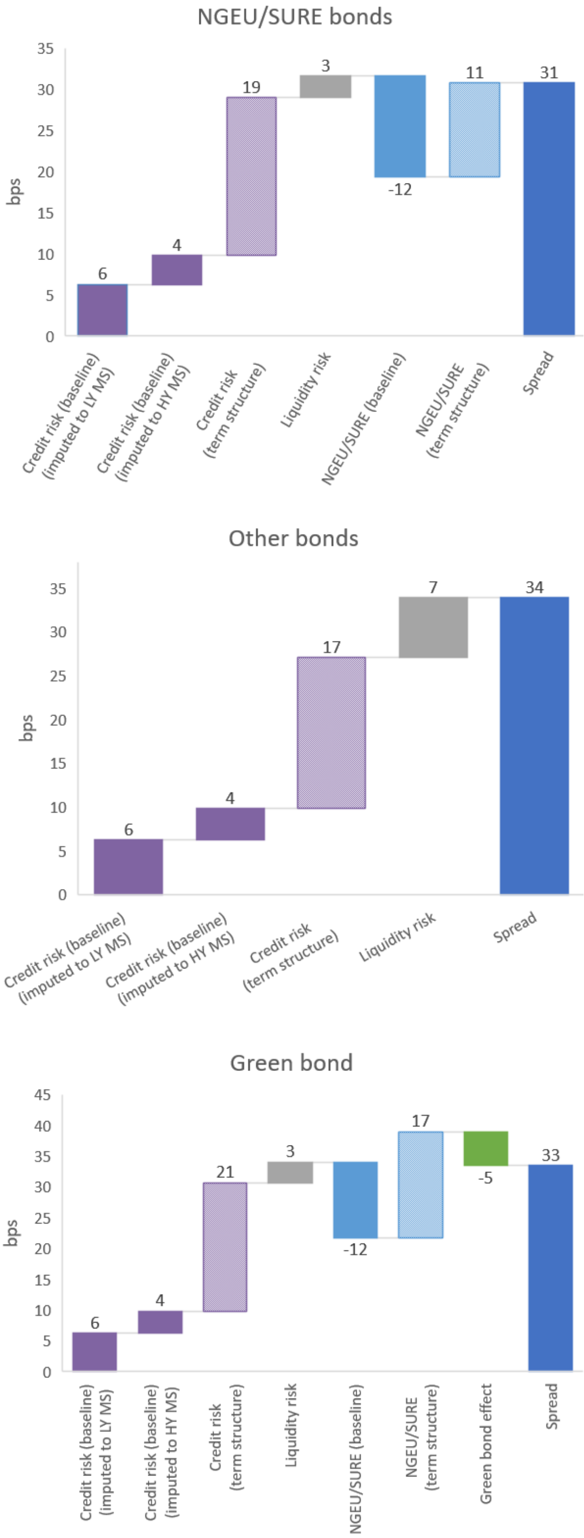
([80]) By 'average bond' we mean a hypothetical bond with maturity and bid-ask spreads equal to the simple average calculated over the respective subsample (i.e. the NGEU/SURE, green and other subsamples).

NGEU/SURE, green and other. As before, a number of key conclusions can be extracted. These conclusions are generally in line with those of the previous subsection (except on the existence of an EU green bond effect):

1. <u>EU spreads can be interpreted as mainly reflecting a modest amount of perceived credit risk</u>. In the decomposition shown in Graph III.6, perceived credit risk is taken as that part of the spread that cannot be explained by a bond's liquidity or other factors. In particular, the intercept *a* is interpreted as a measure of baseline credit risk and decomposed into two regional contributions, according to weights derived from the estimated parameters of the panel regression considered in Subsection III.2 ([81]). The maturity variables *T* and *T*[2] are likewise assumed to reflect a term structure component of credit risk, according to which bonds with longer residual maturities tend to show higher spreads ([82]). This is the reason why NGEU/SURE bonds show a total perceived credit risk that is slightly higher than that of other bonds, as their residual maturity is approximately two years longer on average in the sample.

2. <u>The liquidity of NGEU and SURE bonds is higher on average, allowing for a more favourable liquidity premium</u>. This liquidity advantage is estimated at approximately 4 bps in simple average terms.

Graph III.6: **Decomposition of spreads on 'average' EU bonds as at January 2022**



(1) LY MS refers to "lower-yield" Member States while HY MS refers to "higher-yield" Member States.
Source: Own estimations.

([81]) Concretely, the share of the intercept value assigned to the 'lower-yield' region is given by:

$$\frac{\beta_6 Risk_{Jan\,22}^{LY}+\beta_{10}\left(\overline{T_{Jan\,22}\times Risk_{Jan\,22}^{LY}}\right)}{\beta_6 Risk_{Jan\,22}^{LY}+\beta_{10}\left(\overline{T_{Jan\,22}\times Risk_{Jan\,22}^{LY}}\right)+\beta_7 Risk_{Jan\,22}^{HY}+\beta_{11}\left(\overline{T_{Jan\,22}\times Risk_{Jan\,22}^{HY}}\right)}$$

The share of the 'higher-yield' region is the complement of this figure.

([82]) In principle, β_T and β_{T^2} could also capture term premia differentials between the EU and AAA sovereign bonds that are unrelated to liquidity and credit risk. However, given the relatively similar characteristics of both types of bonds, we assume that any such term premia spread would be only of secondary importance. It is also worth noting that, while this was not the presentational option chosen in Graph IV.6, the term structure component of credit risk could have been decomposed into regional contributions, just like baseline credit risk.

3. NGEU and SURE bonds benefit from a favourable spread-lowering effect, which fades away at longer maturities. This effect is estimated as lowering spreads by 12 bps for bonds approaching zero residual maturity, and is absent beyond the 10-year horizon. Because it disappears at longer horizons, the total effect tends to be modest for the 'average' NGEU/SURE bond (given the associated long average maturity) but it can be quite significant for short residual maturities, as is notably the case for EU bills.

4. The EU green bond appears to benefit from a specific price advantage. The EU green bond is a 15-year bond issued under NGEU and its green label-specific advantage is estimated at 5 bps, although any results involving just one observation should be interpreted with additional caution.

5. There appears to be no statistically significant change in spreads from an 'EU bill label', after controlling for the favourable characteristics of EU bills (i.e. short residual maturity, high liquidity and issuance under the NGEU programme).

Before concluding the present cross-sectional assessment, it may be worth reflecting on the estimated NGEU/SURE effect, discussed under conclusion 3 above. While determining its ultimate nature is beyond the scope of this article, it may be that the perceived credit risk of EU bonds issued under NGEU and SURE benefits from the related guarantees and budgetary safeguards ([83]), as well as from the specific legal framework surrounding the loans to Member States under NGEU. Another possibility may be that certain characteristics of NGEU and SURE bonds have been optimised to cater to current market demand. It may also be the case that investor preferences, preferred habitat effects or other undefined 'goodwill' towards large-scale EU bond issuance under NGEU and SURE play a role. One particular explanation though – related to pricing advantages usually associated with recently issued or 'on the run' bonds – can be apparently be ruled out, as including a dummy variable capturing the latest issued bond (in either the panel data or the cross-sectional regression) produces a statistically insignificant coefficient.

III.4. Liquidity drivers

The previous subsections established that market liquidity, measured by (average) bid-ask spreads (BAS), is a relevant factor driving bond yields. We conclude our empirical investigation of the market performance of EU bonds by looking at the evolution and drivers of this liquidity.

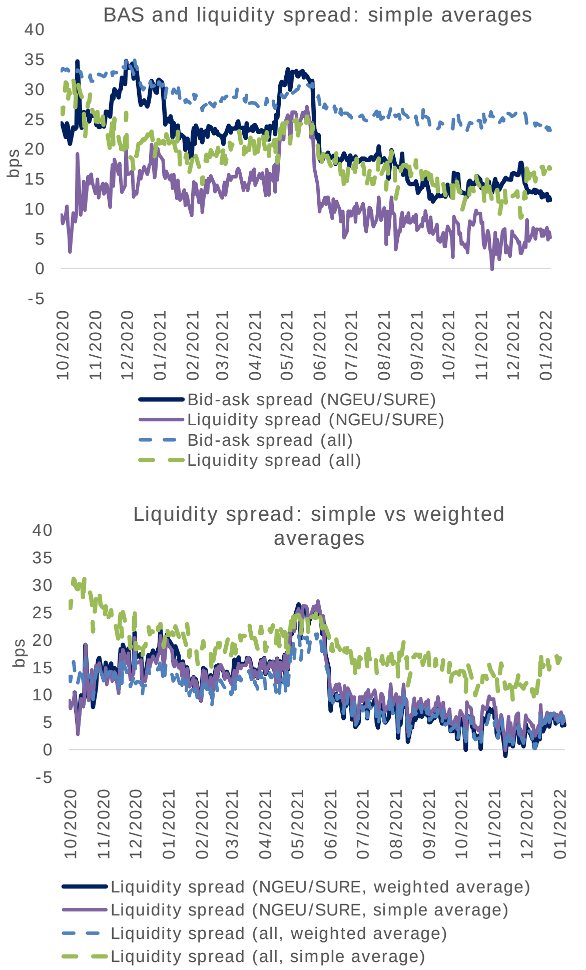
Graph III.7 plots the changes in the average BAS for all EU bonds, as well as for the NGEU/SURE subsample. In addition, the graph also shows an alternative measure of liquidity, which we denote as 'liquidity spread', computed as the difference between a bond's BAS and the BAS of the respective benchmark bond (i.e. the BAS of a 'risk-free' bond of comparable characteristics selected by Bloomberg) ([84]).

As can be observed in the top part of the graph, the average BAS of EU bonds has been on a slight downward trend since October 2020, when the first SURE bond was issued. This downward trend appears largely driven since June 2021 by the NGEU/SURE subsample, whose BAS began reducing from that date onwards. However, the BAS of NGEU/SURE bonds was more volatile before June 2021 (which can also be understood as a consequence of having fewer such bonds in the sample). In the bottom part of the graph, simple averages of liquidity spreads are compared with their weighted average counterparts. The increasing relative size of NGEU/SURE bonds becomes apparent as their low liquidity spreads quickly dominate and lead to a convergence in weighted averages across subsamples. In fact, towards the end of our sample period, average liquidity spreads for NGEU/SURE bonds are consistently low and approaching zero.

([83]) Namely as established in the latest EU own resources decision. See, for example, the European Parliament briefing of June 2021 on National ratification of the Own Resources Decision, available from https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/690520/EPRS_BRI(2021)690520_EN.pdf

([84]) In our sample, benchmark bonds are mostly sovereign bonds and bills issued by Germany.

Graph III.7: **Liquidity dynamics of EU bonds**



(1) The liquidity spread was calculated as the difference between an EU bond's bid-ask spread and the bid-ask spread of the respective benchmark bond, as selected by Bloomberg.
Source: Bloomberg, own calculations.

We formalise the assessment of liquidity drivers in our EU bond sample by running the following panel regression in a random effects setting:

$$BAS_{i,t} = \alpha + \beta_{AMNT} AMNT_{i,t} + \beta_T T_{i,t} + \beta_{TAMNT} TAMNT_t + \beta_{TAMNT2} TAMNT_t^2 + \varepsilon_{i,t}$$

where $AMNT_{i,t}$ is the amount outstanding of bond *i* in month *t*; $T_{i,t}$ is the residual maturity of bond *i* in month *t*; and $TAMNT_t$ is the total amount of EU bonds outstanding in month *t*. Box III.1 discusses the estimation method and presents the estimation results. The goodness-of-fit is 40%, and all the coefficients are highly statistically significant and have the expected sign.

Three key conclusions can be extracted from the estimation results:

1. Market liquidity increases with lower residual maturity. According to the estimated β_T coefficient, reducing residual maturity by one year lowers the BAS by approximately 2 bps, indicating higher liquidity ([85]). This result is thus supportive of the option of issuing EU bills, from a purely financial viewpoint.

2. Larger issue sizes increase liquidity. According to the estimated coefficient β_{AMNT}, an increase in issuance size by EUR 1 bn lowers the BAS by approximately 2.4 bps. As a reference, the average size of the non-NGEU/SURE bond in our sample in January 2022 was EUR 1.33 bn, a figure that rises to EUR 9.6 bn for NGEU/SURE bonds (excluding bills), and to EUR 3.78 bn for NGEU bills. This result is supportive of a strategy whereby EU issuance would be consolidated under large bond amounts.

3. Liquidity conditions improved as the pool of total EU bonds outstanding increased. Not only does the size of an individual bond issue improve its liquidity, but the size of the total pool of outstanding EU bonds also appears to improve liquidity. This latter effect is assessed as non-linear in the regression, as it becomes weaker for larger amounts. According to the estimated coefficients, moving from a pool of EU 55 bn in October 2020 to one of EUR 235 bn in January 2022 has decreased the average BAS by 14 bps ([86]).

There is no evidence from the previously described panel data model that an 'NGEU/SURE', 'green' or 'bill' label affects liquidity per se in a statistically significant manner.

III.5. Conclusion

We have looked at the market performance of EU bonds in terms of their secondary market yields, spreads and market liquidity. Our investigation suggests that EU bonds are low-risk assets with relatively high and increasing liquidity. Their spreads correlate to some extent with those of both

([85]) Shorter residual maturities also lower the interest rate risk taken on by bond dealers, which may also lead to lower BAS.
([86]) The introduction of an EU primary dealer network (PDN) at the of end-May 2021 may also have helped to increase liquidity over time, as the framework governing the PDN provides an incentive for participating institutions to engage in EU bond market making. See https://ec.europa.eu/info/strategy/eu-budget/eu-borrower-investor-relations/primary-dealer-network_en.

'lower-yield' and 'higher-yield' Member States, being somewhat more influenced by the former. This risk dependence appears consistent with economic fundamentals given the loan and budgetary claims of the EU.

Bonds issued under the recent NGEU and SURE initiatives enjoy higher liquidity and lower spreads than bonds issued under previous EU programmes. This NGEU/SURE effect appears in our regression analysis as a statistically significant reduction in yields that fades away at longer maturities, and which cannot be explained by other factors. Whether a similar effect also exists for the single green bond in the sample is more uncertain, although the analysis suggests that was the case as at January 2022. EU bills show particularly low spreads and very high liquidity, which can be largely explained by their short residual maturities and other observable characteristics. In fact, short maturities and large issuance amounts are seen as key drivers of high market liquidity. Another important factor behind the increasing market liquidity of EU bonds has been the swift expansion of the pool of total EU bonds outstanding since October 2020.

The rapid introduction of large-scale EU bond issuance has been an unexpected development brought about by the joint EU policy response to the COVID-19 crisis. The market reception and dynamics of this large and increasing issuance has been very favourable so far, although its main effects extend well beyond the purely financial realm and into the macroeconomics of the euro area. Joint EU issuance has provided a strong signal of commitment to the European project, has helped to fund its main crisis-response tools and has, at the same time, offered the economy a sizeable, temporary Pan-European safe asset.

Box III.1: **Estimation approach and results**

Subsection IV.2 presents a **panel regression of the drivers of the yields of EU bonds**. The sample runs from October 2020 to January 2022 and covers 64 bonds, for a total of 804 observations. Our time-dependent variables are monthly averages of daily figures to reduce possible noise in the data and to focus on the more fundamental relations between variables. The sample comprises 54 active EU bonds (of which 11 were issued under SURE and 6 were issued under NGEU), 6 active NGEU bills, and 4 bonds that matured during the time period under consideration (of which 2 NGEU bills) ([1]). It should be noted that the panel is unbalanced due to bonds being issued and maturing over time.

The following equation is estimated as a random effects (RE) model, where the variables' meaning is explained in the main text:

$$y_{i,t} = \alpha + \beta_1 y_{i,t}^{AAA} + \beta_2 \overline{BAS}_i + \beta_3 BAS_{i,t} + \beta_4 \bar{T}_i + \beta_5 \bar{T}_i^2 + \beta_6 Risk_t^{LY} + \beta_7 Risk_t^{HY} + \beta_8 NGEU_{SURE\,i} + \beta_9 Green_i + \beta_{10}(\bar{T}_i \times Risk_t^{LY}) + \beta_{11}(\bar{T}_i \times Risk_t^{HY}) + \beta_{12}\left(NGEU_{SURE\,i} \times \bar{T}_i\right) + \varepsilon_{i,t}$$

The choice of estimation is strongly supported by a Hausman test of RE versus fixed effects, where the null hypothesis of RE is not rejected for a p-value of 0.95. At the same time, a Breusch-Pagan LM test rejects a pooled OLS approach, thus further confirming the suitability of an RE approach.

The explanatory variables control for the risk-free rate, market liquidity, average maturity (where we allow for a quadratic effect), credit risk in euro area 'lower-yield' and 'higher-yield' regions, NGEU/SURE and green bond effects, as well as for interaction terms that are empirically significant. The latter are namely related to the interplay between maturity and risk factors; and to the interplay between maturity and the NGEU/SURE effect.

The values of the estimated parameters are as follows:

Table 1:
Estimated parameters (random effects yields model)

Parameter	α	β1	β2	β3	β4	β5	β6	β7	β8	β9	β10	β11	β12
Value	-23.62	0.82	0.38	-0.13	1.16	-0.09	0.24	0.06	-11.44	-2.55	0.022	0.005	1.11
p-value	0.000	0.000	0.000	0.000	0.021	0.000	0.000	0.002	0.003	0.747	0.000	0.003	0.010

All parameters are significant at either a 1% or a 5% significance level, with the exception of the parameter associated with $Green_i$, which is not significant. Nevertheless, we retain this variable in our specification for consistency with the cross-sectional regression discussed below, where $Green_i$ will be seen to be significant. The signs of the estimated coefficients are theoretically valid in all cases, with the exception of β_3, the coefficient associated with $BAS_{i,t}$. In fact, while the coefficient associated with the average bid-ask spread $\overline{BAS}_i$ has the expected positive sign (as higher $\overline{BAS}$ implies lower liquidity and thus higher spreads), the evolution of the bid-ask spread over time does not. We attribute this to peculiarities in the sample, as suggested by an observation of Graph IV.7, where: (i) *BAS* tends to decrease over time, even when spreads embarked on a slight upward trend (Graph IV.4); and (ii) *BAS* exhibits an unusual jump in May-June 2021.

In Subsection IV.3, the focus is on an **explanatory cross-sectional regression of the spreads of EU bonds as at January 2022**. The sample includes 61 bonds (of which 11 were issued under SURE and 6 were issued under NGEU) and 7 NGEU bills (one of which matured in early January 2022). The following equation is estimated through OLS and by employing robust standard errors, where the variables' meaning is explained in the main text:

([1]) The sample covers all bonds issued by the EU that have traded during the time period under consideration, as listed in our Bloomberg data source, with the exception of bonds issued by the European Atomic Energy Community. The latter group includes a total of seven bonds, which are characterised by higher yields when compared with the other EU issuances.

(Continued on the next page)

Box (continued)

$$y_i - y_i^{AAA} = \alpha + \beta_{BAS} BAS_i + \beta_T T_i + \beta_{T^2} T_i^2 + \beta_{NS} NGEU\_SURE_i + \beta_G Green_i + \beta_{NS,T} (NGEU\_SURE_i \times T_i) + \varepsilon_i$$

This equation can be understood as a reduced form of the full panel data version, where time-variant variables that are not bond-specific, namely the regional risk factors, collapse to the intercept. Given the decrease in the sample size, the dependent variable is expressed as a spread in order to further reduce the number of parameters. The values of the estimated parameters are as follows:

Table 2:
Estimated parameters (cross-sectional spreads model)

Parameter	α	β_{BAS}	β_T	β_{T2}	β_{NS}	β_G	$\beta_{NS,T}$
Value	9.80	0.21	2.95	-0.10	-12.04	-5.49	1.14
p-value	0.005	0.003	0.000	0.000	0.010	0.001	0.005

All parameters are significant at a 1% or a 5% significance level, and their signs are theoretically valid.

Subsection IV.4 looks into the **drivers of market liquidity in a panel data regression model** for the same bond sample as in Subsection IV.2. The following equation is estimated as an RE model, where the variables' meaning is explained in the main text:

$$BAS_{i,t} = \alpha + \beta_{AMNT} AMNT_{i,t} + \beta_T T_{i,t} + \beta_{TAMNT} TAMNT_t + \beta_{TAMNT^2} TAMNT_t^2 + \varepsilon_{i,t}$$

The inclusion of a quadratic term in total amounts outstanding allows for a non-linear effect, such as a decreasing contribution of this variable for reducing BAS. The RE model is chosen over a fixed effects model following a Hausman test where the RE null hypothesis is not rejected for a p-value of 0.56. The values of the estimated parameters are as follows:

Table 3:
Estimated parameters (random effects BAS model)

Parameter	α	β_{AMNT}	β_T	β_{TAMNT}	β_{TMANT2}
Value	29.01	-2.43	1.96	-0.16	0.00043
p-value	0.000	0.000	0.000	0.000	0.000

All parameters are highly significant and the signs of the estimated coefficients are as expected.